DOCKET: SAMH 100002000 PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**
**BOARD OF PATENT APPEALS AND INTERFERENCES**

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|---|---|---|---|---|
| INVENTOR: | Soon-Tae AHN | ) | EXAMINER: | C.S. Kessler |
| SERIAL NO.: | 10/583,399 | ) | ART UNIT: | 1793 |
| FILING DATE: | November 29, 2004 | ) | DATE: | June 16, 2011 |

FOR: Steel Wire for Cold Forging Having Excellent Low Temperature Impact Properties and Methods of Producing Same

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

## BRIEF FOR APPELLANT

This is an appeal from the final rejection by the Examiner mailed March 11, 2011, rejecting claims 1-6. A notice of appeal and the appeal fee were timely filed on April 29, 2011.

Payment for $270.00 for the appeal brief fee (small entity) is enclosed. Please charge any over or under payment to the assignee's Deposit Account No. 04-0566.

### REAL PARTY IN INTEREST

The real party in interest is the assignee, Samhwa Steel Co., Ltd. of Pusan, Korea, owner of all rights in this application, whose address is 339-4, Samrak-Dong, Sasang-GU, Pusan, Korea.

## RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to appellant or appellant's legal representatives, which will directly affect or be affected by, or have a bearing on the Board's decision on this appeal.

## STATUS OF CLAIMS

All claims of the application, nos. 1-6, stand rejected. The rejections of claims 1-6 are being appealed.

## STATUS OF AMENDMENTS

No amendment was filed after the final rejection of March 11, 2011. All the amendments made during prosecution of the application have been entered and are presently in the application.

## SUMMARY OF CLAIMED SUBJECT MATTER

Appellant's invention as recited in independent claim 1 is directed to a quenched and tempered steel wire which can be cold forged. Specification, p.5, ll.9-28.[1] The quenched and tempered steel wire comprises 0.10 – 0.40 wt% C (specification, p.7, ll.6-17), 1.0 wt% or less of Si (specification, p.7, ll.18-27), 0.30 – 2.0 wt% Mn (specification, p.7, l.28 - p.8, l.7), 0.03 wt% or less of P, 0.03 wt% or less of S (specification, p.9, ll.8-14), and a balance of Fe and impurities (specification, p.6, l.30). The quenched and tempered steel wire has an austenite grain size of 5 – 20 μm

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1 The reference to the specification herein is to the published PCT specification.

(specification, p.9, ll.25-27), impact absorption energy of 60 J/cm$^2$ or more at –40°C (specification, p.10, ll.23-27), and tensile strength of 70 – 130 kgf/mm$^2$ (specification, p.10, ll.18-19).

Appellant's invention as recited in independent claim 3 is directed to a method of producing a steel wire for cold forging. Specification, p.5, ll.9-28. The method comprises induction heating steel (specification, p.11, l.25 – p.12, l.7), which contains 0.10 – 0.40 wt% C (specification, p.7, ll.6-17), 1.0 wt% or less of Si (specification, p.7, ll.18-27), 0.30 – 2.0 wt% Mn (specification, p.7, l.28 - p.8, l.7), 0.03 wt% or less of P, 0.03 wt% or less of S (specification, p.9, ll.8-14), and a balance of Fe and impurities (specification, p.6, l.30), to an Ac3 transformation point or higher (specification, p.5, ll.18-23) so that austenite grain size is 5 – 20 μm (specification, p.9, ll.25-27). The method then comprises cooling the heated steel (specification, p.5, l.23), followed by heat treating the cooled steel (specification, p.5, ll.24-28) in such a way that tensile strength is 70 – 130 kgf/mm$^2$ (specification, p.5, ll.24-28 and p.10, ll.18-19) at a tempering parameter (P) ranging from 21,800 to 30,000 (specification, p.5, ll.25-28), which is expressed by Equation 1, so that impact absorption energy is 60 J/cm$^2$ or more at –40°C (specification, p.10, ll.23-27). Equation 1 is:

$$P = 1.8 \times (T + 273) \times (14.44 + \log t)$$ (specification, p.6, ll.2-3),

wherein, T is a tempering temperature (°C), and t is a tempering time (sec) (specification, p.6, ll.5-6).

## GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The contested issues on this appeal are whether: 1) claims 5 and 6 comply with the written description requirement of 35 USC 112, first paragraph; and 2) claims 1-6 are obvious under 35 USC § 103 from Ahn et al. U.S. Patent Publication No. 2003/0066576.

## ARGUMENT

### I. Rejection under 35 USC § 112, first paragraph

Claims 5 and 6 stand rejected under 35 USC 112, first paragraph, for failing to comply with the written description requirement, namely, for the term induction heating "without plastic deformation."

Support for the term "without plastic deformation" in connection with induction heating is found in the specification at page 5, lines 18-28 and at page 11, line 25 to page 12, line 7, where no plastic deformation is described while heating to the Ac3 transformation point or higher.

By way of background, the specification describes the prior art as using in some instances non-heat treated steel that has been controlled during hot rolling. See, Specification, p.1, l.23 to p.2, l.6. Hot rolling is well understood to require plastic deformation while the steel is heated to a desired temperature, normally above the Ac3 transformation point.

The present invention takes a different course, and describes heat treating the steel wire rod to an Ac3 transformation point or higher to achieve the claimed austenite grain size of 5 – 20 μm, impact absorption energy is 60 J/cm$^2$ or more at –40°C, and tensile strength is 70 – 130 kgf/mm$^2$. As an Example of the instant invention, beginning

at p.11, l.24, a previously hot rolled wire rod was drawn to a diameter of 14.7 mm, and then subject to heating, quenching and tempering to achieve these properties. The specification does not state that the claimed heating method of the present invention, to an Ac3 transformation point or higher, is during hot rolling. The reference to "a hot rolled wire rod" in the Example is to the fact that the starting material had previously been hot rolled, and not that it was currently undergoing hot rolling while the described heating was taking place. Wire rod and other steel products that had originally been hot rolled are often subsequently described as such when they are used as the starting materials in other processes, such as the drawing that appellants describe in their Example. In the same way, appellant describes in the Example that he starts with wire rod that was originally hot rolled, but then describes the subsequent heating method of the present invention as being made with the use of a high frequency induction heater to raise the temperature to an Ac3 transformation point or higher. No plastic deformation is described in connection with such induction heating.

The case cited by the Examiner, *Ex parte Parks*, 30 USPQ2d 1234, 1236 (BPAI 1993), actually supports appellant's position. In the *Parks* case, the absence of any mention of the use of a catalyst was found to support the concept of practicing the method in the absence of a catalyst. The Board stated "[t]hroughout the discussion which would seem to cry out for a catalyst if one were used, no mention is made of a catalyst." *Id.* Likewise, in the present application, the description of the induction heating step would "cry out" for mention of plastic deformation if one were indeed employed. This is because plastic deformation was employed in use of the starting material, i.e., the hot rolled wire rod, and in subsequent cold forging of the wire rod

heat treated according to the invention. The fact that no plastic deformation was mentioned during the actual claimed induction heating step supports the concept that none was used.

Accordingly, the originally filed specification supports appellant's claim to heating steel to an Ac3 transformation point or higher "without plastic deformation."

**II. Rejection under 35 USC § 103**

A. The cited prior art

The Ahn publication, U.S. Patent Publication No. 2003/0066576, is also by the inventor of the present invention. Although the Ahn publication discloses a heating process and austenite grain size in a range partially overlapping that of the present invention, the Ahn publication relies only on the parameter $n \times YS$ to determine suitability for cold forging, where $n$ is the work hardening coefficient and $YS$ is the yield tensile strength.

The Ahn publication does not disclose or suggest the tempering parameter P as disclosed and claimed by appellant, and neither of these prior art parameters $n$ and $YS$ involves the components of the instant claimed tempering parameter P, which are tempering temperature and tempering time in a logarithmic relationship. Moreover, the Ahn publication does not disclose or suggest the particular combination of austenitic grain size, impact absorption energy and tensile strength in the steel wire which results from the processing as disclosed and claimed by appellant.

B. Method claim 3 is not obvious from the Ahn publication

In the claimed method of the present invention as described in claim 3, the inventor induction heats the steel to an Ac3 transformation point or higher so that an

austenite grain size is 5 – 20 μm, and cools the heated steel. Subsequently, the cooled steel is heat treated at a tempering parameter (P) ranging from 21,800 to 30,000, where P is expressed by the equation:

$$P = 1.8 \times (T + 273) \times (14.44 + \log t)$$

wherein, T is a tempering temperature expressed in °C and t is a tempering time expressed in sec. The resulting tensile strength is 70 – 130 $kgf/mm^2$ and impact absorption energy is 60 $J/cm^2$ or more at –40°C,

Neither appellant's method of heat treating according to the tempering parameter (P) nor the resulting quenched and tempered steel wire is obvious from the Ahn publication, which is also by the inventor. The Ahn publication seeks good cold forging properties for high strength quenched and tempered steel wires, but discloses a different process and parameter than the present invention, which process and parameter do not achieve the tensile strength and impact absorption energy as claimed by appellant in the instant application. Although the Ahn publication discloses a heating process and austenite grain size in a range partially overlapping that of the present invention, it does not disclose or suggest the tempering parameter P as disclosed and claimed by appellant. Moreover, the Ahn publication does not disclose or suggest the particular combination of austenitic grain size, impact absorption energy and tensile strength in the steel wire which results from the processing as disclosed and claimed by appellant. It is this novel and unobvious combination of parameters that achieves the unexpected advantage of high tensile strength and impact absorption energy to permit excellent cold forging of the steel wire.

The Examiner's entire case rests on the faulty supposition that "[the] Ahn [publication] teaches that each of the prior austenite grain size, yield strength, and tempering parameter are within ranges overlapping the instantly claimed range. March 11, 2011 Office Action, p.4. This is manifestly untrue, since the prior Ahn Publication mentions nothing about the claimed tempering parameter (P) – because the present inventor had not yet invented it! The Examiner then attempts to correct this misstatement by taking the position that "while [the] Ahn [publication] does not explicitly describe the formulation for P as claimed, the tempering temperature and time are such that the range of P in the invention method of Ahn would overlap that claimed (see [0041])." *Id.* However, any overlap in P (which the Examiner has not detailed) would not take into account the addition of the claimed austenite grain size of 5-20 μm, which is only a small subset of the broad range of 5-90 μm disclosed in the Ahn publication. Additionally, the Ahn publication does not recognize the combination of austenite grain size, tensile strength, tempering parameter P and impact absorption energy that are presently claimed.

Referring to Table 2, the inventor addressed the criticality of the claimed parameters by comparing samples of the present invention with Comparative Examples that had similar properties and processing methods, but did not have the claimed combination of those properties and processing methods. It can be noted that all of the Comparative Examples (CO. EX. 1-13) do not achieve the impact absorption energy 60 $J/cm^2$ or higher at - 40°C. This belies any assertion that the samples processed with the identical material and process to that of the Ahn publication will inherently have the impact absorption energy of the present invention.

The inventor of the present invention unexpectedly found that even though the identical material and similar process was used, the impact absorption energy at - 40°C could be substantially differentiated according to the combination of the tensile strength, the grain size, and the tempering parameter P. That is, it could be found that when any one among the three conditions does not belong to the range of the numerical values claimed in the present invention, it was impossible to obtain the impact absorption energy 60 $J/cm^2$ or higher at - 40°C.

This establishes the criticality that in order to obtain the high impact absorption energy at - 40°C, the organic relation between the tensile strength, the grain size, and the tempering parameter P is very important and must meet the values recited in appellant's claims. The cited Ahn publication makes no suggestion of the criticality of any of these parameters and, further, does not even recognize the tempering parameter P in any manner. By contrast, the Ahn publication relies only on the parameter $n$ x $YS$ to determine suitability for cold forging, where $n$ is the work hardening coefficient and $YS$ is the yield tensile strength. Neither of these prior art parameters involves the components of the instant claimed tempering parameter P, which are tempering temperature and tempering time in a logarithmic relationship. Therefore, the present invention specifies and simplifies the tempering through the introduction of the tempering parameter P in such a way as for anyone to easily apply it to produce a quenched and tempered steel wire of the claimed excellent impact absorption energy and tensile strength which can be cold forged.

Accordingly, appellant's claimed process parameters and the properties of steel wire produced thereby are not obvious from, and patentably distinct over, the disclosure of the Ahn publication.

C. Claims 1 and 2 are not obvious from the Ahn publication

Appellant's quenched and tempered steel wire is defined in claims 1 and 2 with the same composition, austenite grain size, tensile strength and impact absorption energy as recited in method claims 3-6.

The Ahn publication does not disclose or suggest the particular combination of austenitic grain size, impact absorption energy and tensile strength in the steel wire as disclosed and claimed by appellant. It is this novel and unobvious combination of parameters that achieves the unexpected advantage of high tensile strength and impact absorption energy to permit excellent cold forging of the steel wire.

Accordingly, appellant's claimed properties of steel wire are not obvious from, and patentably distinct over, the disclosure of the Ahn publication.

## CONCLUSION

For the reasons given above, appellant submits that the claims of the instant application fully meet the requirements of 35 USC §§ 112, first paragraph, and 103(a). Reversal of the rejection is respectfully requested.

Respectfully submitted,

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**CLAIMS APPENDIX**

**Rejected Claims of Serial No. 10/583,399**

1. (previously presented) A quenched and tempered steel wire which can be cold forged, comprising 0.10 – 0.40 wt% C, 1.0 wt% or less of Si, 0.30 – 2.0 wt% Mn, 0.03 wt% or less of P, 0.03 wt% or less of S, and a balance of Fe and impurities, wherein an austenite grain size is 5 – 20 μm, impact absorption energy is 60 $J/cm^2$ or more at –40°C, and tensile strength is 70 – 130 $kgf/mm^2$.

2. (original) The steel wire as set forth in claim 1, further comprising at least one component selected from the group consisting of 0.05 – 2.0 wt% Cr, 0.05 – 1.5 wt% Mo, and 0.0003 – 0.0050 wt% B.

3. (previously presented) A method of producing a steel wire for cold forging comprising:

induction heating steel, which contains 0.10 – 0.40 wt% C, 1.0 wt% or less of Si, 0.30 – 2.0 wt% Mn, 0.03 wt% or less of P, 0.03 wt% or less of S, and a balance of Fe and impurities, to an Ac3 transformation point or higher so that an austenite grain size is 5 – 20 μm;

cooling the heated steel; and

heat treating the cooled steel in such a way that tensile strength is 70 – 130 $kgf/mm^2$ at a tempering parameter (P) ranging from 21,800 to 30,000,

which is expressed by a following Equation 1, so that impact absorption energy is 60 $J/cm^2$ or more at –40°C,

Equation 1

$$P = 1.8 \times (T + 273) \times (14.44 + \log t)$$

wherein, T is a tempering temperature (°C), and t is a tempering time (sec).

4. (original) The method as set forth in claim 3, wherein the steel further comprises at least one component selected from the group consisting of 0.05 – 2.0 wt% Cr, 0.05 – 1.5 wt% Mo, and 0.0003 – 0.0050 wt% B.

5. (previously presented) The method as set forth in claim 3, wherein the steel is induction heated without plastic deformation.

6. (previously presented) The method as set forth in claim 4, wherein the steel is induction heated without plastic deformation.

## EVIDENCE APPENDIX

Declaration Under Rule 132 of Soon-Tae Ahn entered on March 15, 2010.

DOCKET: SAMH100002000 PATENT

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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|---|---|---|---|---|
| INVENTOR: | Soon-Tae Ahn | ) | EXAMINER: | C.S. Kessler |
| | | ) | | |
| SERIAL NO.: | 10/583,399 | ) | ART UNIT: | 1793 |
| | | ) | | |
| FILING DATE: | November 29, 2004 | ) | DATE: | March ___, 2010 |
| | | ) | | |
| FOR: | Steel Wire for Cold Forging Having Excellent Low Temperature Impact Properties and Methods of Producing Same | ) | | |

## DECLARATION UNDER RULE 132

Mail Stop ____________
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Soon-Tae Ahn, do hereby declare as follows:

1. I am the named inventor of the above-identified patent application. I have a Ph.D degree in Metal

Materials from Busan National University in Korea .

I am a director at Samhwa Steel Co. Ltd., assignee of the above-identified application, and have 24 years of experience working in the manufacture of steel wire for cold forging, including shaping, heat-treating and testing of such wire. I believe that I am skilled in the art of manufacturing steel wire and am competent to testify to the matters described herein.

2. I am familiar with the above-identified application and the steel wire for cold forging disclosed and claimed in claims 1-4. I understand that these claims stand rejected from Kanisawa et al. U.S. Patent Publication No. 2002/0040744.

3. I am offering this declaration to overcome the rejection of claims 1-4 over the Kanisawa reference, specifically the invention as described and claimed in claims 1-4 is anticipated by or obvious from the Kanisawa reference.

4. The claimed method of the present invention is distinguished from the prior art Kanisawa process, wherein the heating is performed while hot rolling the steel wire. Kanisawa describes in paragraph 0033 the hot

rolling of the steel to a finish rolling temperature from the $Ar_3$ transformation temperature to 200°C above it.[1] Kanisawa also describes in the same paragraph that such hot rolling process produces a prior austenitic grain size of 11 or above. Although the achieved austenite grain size overlaps with applicants' invention, Kanisawa's processes for obtaining the fine is different. Accordingly, Kanisawa not only does not disclose applicant's heating step that occurs without plastic deformation, but in fact *teaches away* from applicants' process as defined in claim 3.

5. Kanisawa also does not disclose applicants' claimed tempering parameter (P) ranging from 21,800 to 30,000. P is expressed by a following Equation 1:

$$P = 1.8 \times (T + 273) \times (14.44 + \log t)$$

wherein, T is a tempering temperature expressed in °C and t is a tempering time expressed in sec.

6. Applicant's composition with the resultant claimed properties, as defined in claims 1 and 3, is not anticipated by or obvious from Kanisawa.

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[1] The present invention specifies the "Ac3" transformation temperature, while Kanisawa specfies the "$Ar_3$" transformation temperature. The "c" in applicants' term $Ac_3$ is taken from

The present invention solves the problem of dramatically deteriorated impact properties when a conventional steel wire for cold forging is used as in automobiles or other devices in a severely cold regions by providing a steel wire having high impact properties of 60 J/cm$^2$ or more at a cryogenic temperature of -40°C, even though the hot-rolled steel wire is quenched and tempered with high tensile strength of 70 - 130 kgf/mm$^2$. By contrast, the object of Kanisawa is to provide a steel wire rod for cold forging which can be applied to spheroidizing annealing without a preliminary drawing that is conventionally conducted before the annealing. Notwithstanding overlap in composition and prior austenitic grain size range, the Kanisawa steel wire is incapable of achieving the unexpectedly advantageous claimed properties of applicants' invention.

7. The differences may be explained by reference to Kanisawa' described treatment processes and reported properties for the steel wire. Kanisawa employs a hot rolling process in which billets of 162 mm x 162 mm in section were heated at a high temperature and continuously plastically deformed by hot rolling into wire rods 11 mm in diameter. The

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the French term "chauffage" having a meaning of heating and the "r" in Kanisawa's term $Ar_3$

finish hot rolling was at a relatively low temperature of from $Ar_3$ to 200°C above it (800°C) in order to reach the final size, following by being rapidly cooled and then tempered at 500°C. After tempering, the wire underwent spheroidizing annealing at the retention temperature of 740°C for a resident time of 17 hours. Kanisawa, Example 1 and Table 2.

8. The combination of tensile strength and impact absorption energy as defined in the claims of the present invention is also not disclosed or suggested by Kanisawa. Although the steel wire rod produced by Kanisawa immediately after hot rolling, rapid cooling and tempering in Table 3 shows a tensile strength similar with that of the present invention (up to 978 MPa = 99 $kgf/mm^2$), the steel wire rod cannot be applied to cold forging. Instead, Kanisawa teaches that the wire must undergo spheroidizing annealing, in which case the tensile strength level of the steel wire after annealing and before the cold forging is considerably lower (up to 568 MPa = 57 $kgf/mm^2$) than applicants' claimed range of 70 – 130 $kgf/mm^2$.

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is taken from the French term "refroidissement" having a meaning of cooling.

9. In my experience and opinion, the impact absorption energy of Kanisawa's wire immediately after tempering would not have been at least 60 $J/cm^2$ at -40°C, as in the present invention. This is because the method for obtaining the prior austenite grain in Kanisawa is completely different from that in the present invention (hot rolling versus no plastic deformation in the present invention), the Kanisawa microstructure (include the prior austenite grain) immediately after quenching has lots of stress in it because of severe plastic deformation during hot rolling in low temperature. It could be easily anticipated that the stresses will be hardly relieved even though the structure gets tempering after quenching, so Kanisawa acknowledges that the wire must be further spheroidized annealed before it is capable of being cold forged. [ By contrast, the microstructure of the present invention does not have that stress in it during the heat treatment step. ]

The claimed impact absorption energy of at least 60 $J/cm^2$ at -40°C requires significantly more ductility than what is obtained by Kanisawa immediately after tempering.

10. Although Kanisawa's wire ductility is improved after spheroidizing annealing (when it is ready for cold forging), the tensile

strength level of up to 568 MPa (57 kgf/mm$^2$) is considerably lower than applicants' claimed range of 70 - 130 kgf/mm$^2$.

11. Kanisawa only achieves the claimed tensile strength when it has an impact absorption energy lower than applicants' claimed range of at least 60 J/cm$^2$ at -40°C, and Kanisawa only achieves the claimed impact absorption energy when it has a tensile strength lower than applicants' claimed range of 70 - 130 kgf/mm$^2$. Only the present invention discloses and claims a steel wire for cold forging that has the superior combination of impact absorption energy of at least 60 J/cm$^2$ at -40°C and a tensile strength of 70 - 130 kgf/mm$^2$.

12. I declare further that all statements made herein of my own knowledge are true and that all statements made herein on information and belief are believed to be true; and further that I am warned that willful false statements and the like so made are punishable by fine or imprisonment or both, under §1001 of Title XVIII of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Soon Tae Ahn

Soon-Tae Ahn

March 4, 2010

Date

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## RELATED PROCEEDINGS APPENDIX

None